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Thin Film Deformation Behavior of Polystyrene Grafted Nanoparticle Assemblies YANG JIAO, MING-SIAO HSIAO, LAWRENCE DRUMMY, RICHARD VAIA, Air Force Research Laboratory, WPAFB — Assemblies of polymer-grafted "hairy" nanoparticles (HNPs) are of current interest for a wide array of mechanical, photonic and electrical applications. In contrast to nanoparticles dispersed in a free polymer matrix, the grafted polymer determines particle spacing and circumvents nanoparticle agglomeration. The extent to which these grafted polymers are entangled determines the robustness and strength of the HNP assembly. Here in, we investigate the correlations between grafted polymer conformation, entanglements and deformation mechanisms of thin film assemblies of polystyrene-grafted HNPs by controlling the HNP architecture (grafting density and molecular weight). HNPs with varied corona structures are synthesized with surface-initiated controlled/living radical polymerization. Thin films with controlled thickness are prepared by flow coating. Plastic deformation of thin films are examined using static (bright field, HAADF-STEM, tomography) and AFM techniques. Results show a decrease of void density in craze as grafted polymer length increases for semi-dilute polymer brushes. These correlations between HNP architecture and assembly deformation and failure modes refine the HNP design space for the synthesis and fabrication of assemblies with excellent mechanical properties.

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